

# Energy Efficiency Action Plan for Buildings in Sofia



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**Project Title:** Energy Efficiency Action Plan for Buildings in Bulgaria

**Leader:** Municipality of Sofia (Sofia, Bulgaria)

**Partner:** Project Partner: Good Consulting (Washington Grove, MD US)

**Location:** Sofia, Bulgaria

**Project Duration:** July 1999 – July 2000

**EcoLinks Project Investment:** Total Project Investment: \$71,704; EcoLinks Grant Support: \$45,300; Project Team Cost Share Contribution: \$26,404.

## Best Practice: Transferable Solution

This project is a Best Practice. It established and tested an energy audit methodology to identify and prioritize large-scale heat conservation measures in hundreds of public and residential buildings. The project team's approach to developing an energy efficiency action plan, including the audit methodology, can be transferred to other municipalities in the region. Transferability is enhanced with special attention to the particular physical and technical features of target buildings and the district heating system and the legal and regulatory barriers to implementation that may vary from one country to the next.

## Project Summary

Sofia, the capital of Bulgaria with 1.2 million inhabitants, consumes energy for heating purposes at almost twice the rate of the European standard. This results in excessive energy costs and high CO<sub>2</sub> emissions. Sofia Municipality, which is made up of 24 administrative districts, decided to establish an energy conservation program to reduce both energy consumption and air pollution. With an EcoLinks Challenge Grant, it teamed up with an

American consulting company and a Bulgarian NGO to develop an Energy Efficiency Action Plan.

According to a previous study, Sofia's energy consumption for heating purposes is 240 kWh/m<sup>2</sup>, which considerably exceeds the average European standard of 140 kWh/m<sup>2</sup>. As a result of the high level of energy consumption, CO<sub>2</sub> emissions are estimated to exceed 800,000 tons annually. The main reasons for this high rate of consumption are excessive heat losses from the buildings due to inadequate thermal insulation and poor construction; an inefficient heat distribution system; and a lack of radiator control devices. The central heat distribution system is inefficient partly due to the lack of automatic regulation and measuring equipment in many of the sub-stations. Since the project's energy conservation program is implemented, it will result in energy savings amounting to 1,100,000 MWh and a reduction of CO<sub>2</sub> emissions by 240,000 tons per year. The necessary investment outlay for the implementation of the basic energy conservation measures is \$2.3 million for public buildings and \$31.5 million for residential buildings. The average payback period is 1.2 years for public buildings and 1.6 years for residential buildings.

## Project Activities

Sofia Municipality's overall goal is to reduce energy consumption by 30% by introducing cost-effective energy conservation measures in both residential and public buildings. In addition to saving money, the Municipality expects to reduce emissions of CO<sub>2</sub> and other pollutants. The EcoLinks Challenge Grant enabled the Municipality to get started by funding the development of an energy efficiency action plan. The objectives of this plan were to assess energy consumption in both public and residential buildings; identify appropriate energy conservation measures; and prepare a long-term energy conservation plan that defines the necessary financing, possible financial resources, and implementation steps for the selected measures.

The main activities of the project were the following:

### **1. Collected data on current energy consumption**

Action: The available data on current energy consumption were collected for both public and residential buildings. The data consisted of the general characteristics and the present condition of the buildings as well as the consumption of heat and electric energy. The buildings were then classified into different groups according to their function, structure and energy consumption.

Product(s): 1) Data on energy consumption of public and residential buildings  
2) Building classification.

### **2. Developed and conducted an audit**

Action: Two kinds of energy audits were conducted. First, a preliminary audit of the approximately 300 buildings owned by the Municipality was conducted by

administering a questionnaire. The results were put into a database to support project implementation at later stages. The database, comprising the results of the preliminary energy audit, is an MS ACCESS 97 application. For each building, approximately 40 different categories of data were collected and put into the database. This database can be used for analysis using different criteria. In addition, the database can be easily updated with new information. Second, a detailed audit was conducted on two sample buildings, a school and a residential building. Computer models were used to determine current heat losses and to estimate the potential for energy savings.

Product(s): 1) Preliminary audit of approximately 300 buildings 2) Detailed audit of two sample buildings 3) Computer model of heat loss and energy savings potential 4) A database created from the results of the preliminary energy audit.

### **3. Identified energy conservation measures**

Action: A list of energy conservation measures was prepared based on an analysis of the results from the preliminary audit. The list included basic measures such as the installation of meters to measure heat consumption and thermostatic valves and the “weatherization” of doors and windows. For each measure, investment requirements were determined along with the simple payback period. Possible administrative and regulatory barriers to implementation of the energy conservation program were identified.

The project team identified potential barriers to program implementation. For each one, the team recommended a possible remedy. The following barriers were identified:

#### **Legal Barriers:**

Numerous changes are necessary in the Law on Energy and Energy Efficiency and in the Law on Property such as:

- Determination of the procedure for decision-making in the buildings;
- Simplification of the procedure for collection of payments by the heat distribution company;
- Regulation of the activities of Energy Agents, and the interrelations between consumers and agents;
- Creation of the conditions for the practical implementation of a “shared-savings” scheme; and
- Establishment of a legal base for an association of owners and tenants to co-manage common property.

#### **Financial Barriers:**

- The Municipal budget does not include a line item for “energy” and the expenses are only examined yearly for statistical reporting purposes.
- The Municipal budget is centralized and the users of municipal buildings are not stimulated to save energy.
- Sofia Municipality is restricted from funding energy-saving projects from its own resources.
- Sofia citizens have limited financial resources.

#### Organizational and Administrative Barriers:

- The Municipality has no organizational unit for planning and controlling energy use; there is no commission for energy planning.
- Information on energy consumption is rarely analyzed and used to prevent over-consumption.
- There is no monitoring of energy efficiency measures.

#### Social and Psychological Barriers:

- Citizens and some managers are not aware of the energy savings potential.
- Citizens mistrust the power production industry due to its monopolistic structure.
- The opportunities for dialogue between the Municipality and non-governmental associations are not fully used.

Product(s): 1) A list of energy conservation measures 2) Administrative and regulatory barriers to implementation of the energy conservation program 3) Database based on the preliminary energy audit from questionnaires received from 300 municipal buildings.

### **4. Prepared action and marketing plans**

Action: An action plan was prepared and included all the technical improvements necessary to implement the energy conservation program along with the costs, risks and possible financing sources. It also provided for the creation of new institutions to operate the program. The marketing plan primarily targeted owners of private residential buildings as their buy-in is essential to implementing the program in residential buildings. Draft plans were prepared and discussed in numerous meetings attended by municipal authorities, consulting companies, associations, equipment suppliers and residents. A separate workshop was organized to present the results of the energy audits and to discuss the priorities of the action plan. As a result of these public discussions, the action and marketing plans were finalized.

The Action Plan included 1) a schedule for the implementation of the energy conservation measures over a 3-12 year period, depending upon the different ownership of the buildings; 2) financial considerations including the extent of the owners' ability to finance the conservation measures, and 3) institutional barriers. One consideration was to implement the easier, less expensive measures in the first three years before expiration of the current Mayor's term. A track record could then be established before the inauguration of a new Mayor.

A noteworthy initiative in the Action Plan was the creation of an Energy Efficiency Fund to finance the implementation of the energy efficiency measures in the buildings owned by the Municipality. The Fund would be initially capitalized at \$2.5 million and provide an investment structure for implementing the energy efficiency measures that have the highest rate of return and shortest payback period. The money saved from reduced energy consumption would be returned to the Fund and invested in other measures on a revolving basis. It is estimated that the Fund would generate \$51 million for investment in energy efficiency over a period of twelve years with the initial \$2.5 million being fully recovered.

Tasks planned for the 314 municipal buildings over the first three years included the following:

- Installation of substation calorimeters (result: initiation of monitoring and accounting of heat consumption; financing from the World Bank loan).
- Establishment of the self-recovery Energy Efficiency Fund (result: financing solution for implementation of the Action Plan; investment required: \$2.5 million from the Municipality or external resources).
- Installation of substation regulators (required investment: \$1.4 million, payback period 0.9 years; financing through the Fund).
- Installation of thermostatic valves on the radiators (required investment: \$800,000; payback period 0.8 years; financing through the Fund).
- Reparation and tightening of door and window frames (required investment: \$125,000; payback period 1.53 years; financing through the Fund).

For the residential buildings, a \$31.5 million investment would be needed to implement basic energy efficiency measures over three years. This investment would be funded by bank loans repaid through energy savings. Consumers would continue to pay their heating bills at the regular rate, and the money saved from reduced energy consumption would be directed to loan repayment.

Two new agencies would be created to manage this part of the program: “Energy Agents” and “Municipal Agency for Energy Management”. Energy Agents would collect payments from consumers. Then it would pay the energy provider for actual heating expenses and send the surplus funds to the banks for loan repayment. It is estimated the loans would be repaid in four years. The Municipal Agency for Energy Management would implement the energy conservation measures in the residential units using the loan proceeds to hire subcontracted companies.

Tasks planned for the 300,000 residential units over three years included the following:

- Installation of substation calorimeters (10 000 substations; financing by the Municipality or through a loan from the World Bank).
- Installation of substation regulators (third party financing or a loan from the World Bank).
- Installation of thermostatic valves (financed by occupants through various possible mechanisms; altogether \$22.5 million required; payback time 1.25 years).
- Tightening of door and window frames.

A Marketing Plan was designed to obtain support from residential building owners. Their support is crucial since they are responsible for financing energy efficiency improvements in this sector. The Plan was based on a marketing analysis of the proposed energy conservation measures and the income levels of Bulgarian citizens. It was scheduled for implementation in two stages, a pilot project and a final project. The pilot project would concentrate on encouraging the residents of one building to participate in the program. Equipment suppliers and other businesses would be asked to sponsor the pilot stage. The final project would be aimed at obtaining the

participation of 66% of homeowners in Sofia and reducing their energy bills by at least 16%.

The Plan included the following items:

- Segmentation of the Market: the market would be clarified to identify target customers;
- Project Promotion: A positioning strategy to communicate a favorable image for the program and create demand for it would be developed. The program would be promoted amongst residents based on 1) its capacity to provide greater heating, 2) level of convenience, and 3) cost savings; and
- Sponsorship Strategy: This would be used to enlist equipment suppliers and others to support promotional campaigns.

Product(s): 1) Action plan 2) Marketing plan 3) Action Plan review meetings with municipal authorities, consulting companies, associations, equipment suppliers and residents 4) Workshop to discuss action plan.

## **5. Conducted follow-up activities**

Action: The project team submitted a proposal to the European Union's SAVE 2 Program to set up the Municipal Agency for Energy Management, as called for in the Action Plan. The proposal was accepted and the project team expects to receive EURO 120,000 for three years. Sofia was one of four European cities selected to receive this grant. A proposal for additional financing was also submitted to the UN Economic Commission of Europe's Energy 21 program.

Product(s): 1) EU grant proposed and received to set up Municipal Agency for Energy Management 2) Grant proposal to UN-ECE; status pending.

# **Project Benefits**

This project provides capacity building benefits and environmental and economic benefits. The network established through this project strengthened the capacity of the project participants' to work in a collaborative setting, to implement an energy efficiency program and to address future problems in which the participation of similar stakeholders is crucial. With emissions reductions and energy savings, this project generates both environmental and economic benefits.

## **Capacity Building Benefits**

This project builds the capacity of multiple stakeholders to improve and benefit from energy efficiency. This project strengthened a network of interested parties to reduce energy consumption that provides multiple benefits to residents, the Municipality, consulting companies, associations concerned about consumer and environmental issues, and equipment suppliers. This collaborative network makes it possible to implement an energy efficiency plan as well as address future problems requiring similar stakeholder participation. These stakeholders participated in reviewing the Action Plan established in this project and, therefore, strengthened the implementation

capacity of the energy efficiency program designed by this project. A workshop on the project results was also conducted to disseminate the benefits of the project's methodology and promote further implementation of the project.

### Environmental Benefits

The most notable environmental benefit from this project is the reduction in carbon dioxide emissions. The reductions in emissions are outlined in Table 1. More careful use of energy resources provides economic savings from a decrease in energy consumption and avoids unnecessary pressure on valuable, non-renewable resources.

Table 1. Emissions Reductions

Sector	Annual Reductions of CO <sub>2</sub> Emissions (t/year)
Municipal buildings	19 600
Residential buildings	224 000
Total	243 600

### Economic Benefits

The economic benefits generated from this project are best reflected in reduced energy costs. Table 2. outlines the reduction in energy consumption and annual savings. As noted in Table 2., the annual savings amount to approximately \$40 million. Table 3. provides an overview of the financial analysis for the long term energy efficiency plan.

Table 2. Energy Savings

Sector	Energy Savings (MWh/year)
Municipal buildings	125 000
Residential buildings	975 000
Total	1 100 000

Table 3. Financial Analysis

Financial Analysis	Municipal buildings	Residential buildings
Investment outlays (million USD)	3.2	53.8
Annual savings (million USD)	5.9	34
Payback period (years)	0.5	1.6

The EcoLinks grant of \$45,300 will foster environmental investments of \$57 million when fully implemented.

## Lessons Learned

The following lessons were learned from this project:

- Although the Action Plan has a long-term outlook (up to twelve years), a short-term window was included to encourage the implementation of concrete, simple measures as quickly as possible. In this way, results can be achieved despite future political or economic changes and a track record can be established that will be needed for continued support.
- It is important to obtain political support. The project was strengthened by the commitment of the management of the Sofia Municipality.
- If information on current energy consumption and building stock characteristics is not available, then it is important to plan a data collection strategy at the beginning of the project. The project team was unexpectedly faced with this situation, and spent a considerable amount of time creating a database that includes this information.

## Contact Information

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